

REMARKS

This application pertains to a novel process for separating solids, such as catalysts, present in dissolved or colloidal form from solutions in a nonaqueous solvent with the aid of a membrane.

The membrane used in Applicants' process has a hydrophobic coating. The hydrophobic coating is produced on the membrane by treatment with silanes (page 4, line 7). The silanes used are those of the general formula $R_1R_2R_3R_4Si$, wherein at least one but at most three of the groups R_1 to R_4 are hydrolyzable groups, e.g. -Cl, -OCH₃ or -O-CH₂-CH₃ and/or at least one but at most three of the groups R_1 to R_4 are nonhydrolyzable groups, e.g. alkyl groups or phenyl groups.

Claims 1-8, 10, 11 and 15-17 are pending.

Claims 1, 3-8, 10, 11, and 15-17 stand rejected under 35 U.S.C. 102(b) as anticipated by Cohen (US 6,440,309).

In this reference Cohen first reacts his ceramic membrane with a vinyl terminated lower alkoxy silane, and then reacts the vinyl groups of the silane (which is now chemically bonded to the ceramic membrane) with vinyl monomers by graft polymerization. The monomers used can be either water soluble or water insoluble (see col. 8, lines 55-67 for examples). By this method, it

appears that Cohen can achieve a hydrophobic coating on his ceramic membrane. This is different than Applicants' process, since Applicants are able to use just the silane alone to form the hydrophobic coating, and do not have to perform the second step of graft polymerization.

In addition, Cohen deals with the separation method of pervaporation. The membrane separates liquid mixtures, however, as described in the abstract:

"The resulting ceramic-supported polymer membrane is useful for pervaporation separation of liquid mixtures that are **sufficiently different in their vapor pressure.**"

In contrast to Cohen, Applicants' claims are directed to a nano filtration which separates homogeneously dissolved compounds from their respective non-aqueous solvents; the vapor pressure is of no relevance for this process.

The difference between the two processes lies in their separation mechanisms. While the nano filtration process requires a porous membrane with pores and the separation is achieved via the different sizes of the dissolved compound on the one hand and of the pores on the other hand (similar to an ordinary filter or sieve), the pervaporation membrane is closed and normally of polymeric material, the feed material is provided as a liquid, and a vacuum is applied to the permeate side so that the component which has the higher

solubility in the polymeric material can diffuse through the membrane and is condensed on the permeate side.

These membranes are either hydrophilic or hydrophobic, depending on whether the water or the organic solvent shall be removed (col. 1, lines 1-23).

See also (col. 1, lines 33-42): "...by surface modification of the ceramic substrate with grafted polymer chains, forming an asymmetric covalently-bonded polymer surface layer...polymer stability far superior to membranes which are simply coated..."

(Col. 1, lines 64-67): "The present invention, in contrast, consists of a ceramic membrane support with polymeric chains chemically attached to the ceramic support."

(Col. 3, lines 37-40): "Second, the present surface modification is based on a liquid-phase free-radical graft polymerization..."

The process described in the Cohen reference is therefore clearly completely different than that defined by Applicants' claims, and the rejection of claims 1, 3-8, 10,11, and 15-17 under 35 U.S.C. 102(b) as anticipated by Cohen (US 6,440,309) should now be withdrawn.

Claims 1-8, 10, 11 and 15-17 stand rejected under 35 U.S.C. 102(b) as anticipated by Karau, et al (US 6,472,571).

Karau (discussed in Applicants' specification at page 2, line 15 et seq. as EP 1 088 587 A2) describes a process for the production of organic compounds in a membrane reactor.

In their specification, Applicants' point out that:

"Published specification EP 1 088 587 A2 describes the use of ceramic membranes for retaining dissolved catalysts increased in molar mass in organic solvents. As a result of enlarging the catalyst, the size difference between the product to be discharged and the catalyst to be retained increases. In addition, good retention, which is not impaired by the wetting of the pore walls with the solvent, can be achieved using larger pores.

However, a ceramic membrane can be used in a truly economical manner only if the material flow rate achieved through the membrane meets industrial requirements."

Industrial requirements are e.g. a flow of 5 kg/hm² at up to 40,000 hPa.

Karau describes the retention of dissolved catalyst increased in molar mass by inorganic membranes which can be organically modified.

In Example 1 a ceramic membrane with a pore diameter of < 0.9 nm was used; no modification was indicated. The flows of THF and methanol are high

compared to polymeric membranes. The flows while retaining a compound were not measured.

Example 2 deals with the filtration of a reaction solution in cross-flow mode. The molecule to be retained has a molecular weight of at least 38,000 g/mol. Solvent flows are not described.

Applicants' process cannot be carried out with the membranes disclosed by Karau. Karau's disclosure is broad and not sufficiently supported by evidence nor experimental data.

In contrast to Karau, Applicants' process separates unmodified compounds and that means compounds that are significantly smaller than the ones described by Karau, which are dissolved homogeneously e.g. as catalysts (separation of 90% of the target component) from styrene 500g/mol (membrane type c) and 340 g/mol (membrane type d). For this purpose an inorganic membrane is used with a pore diameter of 2 to 5 nm. The membrane has to be hydrophobically modified, otherwise there is insufficient flow through the membrane (see page 2, line 28 et seq. of Applicants' specification, i.e., "We have now discovered that the cause of this behavior is the strong hydrophilic character of the ceramic micropores, which is due to the fact that water or OH groups become attached to the oxidic surface. These micropores are not permeable to organic solvent molecules. Transport takes place via larger pores and/or

defects, which occupy only a small proportion of the total pore volume. Consequently, the flow decreases in comparison with the flow of water. The retention by these larger pores or defects is substantially above the average pore size of the membrane.")

The state of the art offers two options:

- a) the unmodified catalyst is well retained but the flow is insufficiently low,
or
- b) the flow is of economic relevance, but the retention of the catalyst when
being small sinks below 90%.

The inventive process is possible only with a modified membrane whereby the smallest pore sizes (< 0.9 nm) are not modified, but rather the larger pores and/or defects which as a result of the modification reach the required small pore sizes necessary for the separation process.

Therefore no reading of Karau could possibly lead to Applicants' novel process, and the rejection of claims 1-8, 10, 11 and 15-17 under 35 U.S.C. 102(b) as anticipated by Karau, et al (US 6,472,571) should now be withdrawn.

Claims 2 and 12-14 stand rejected under 35 U.S.C. 102(b) as anticipated by Cohen, or in the alternative, under 35 U.S.C. 103(a) as obvious over Cohen as applied to claim 1 above and further in view of WO 01/07157. The anticipation branch of this rejection is predicated on the Examiner's conclusion that the membrane used in Cohen is the same as that recited in Applicants' claims. As shown above, however, the two membranes are not the same, and the anticipation branch of this rejection should be withdrawn for at least that reason.

As for the obviousness branch of this rejection, the Examiner contends that it would be obvious to use the Cohen membrane for the WO process. However, even if this were done, Applicants' process would not be arrived at, as Cohen's membrane is different than Applicants'

Further, it is not seen how the teaching of the Cohen reference could possibly be applied to that of the WO reference but, even if it were, Applicants novel process could not possibly be arrived at. Cohen teaches to form a polymeric membrane by graft polymerization upon a silane anchoring material which itself is chemically attached to the surface of a ceramic membrane by a silation reaction. Certainly the WO references ceramic or metal membranes could not be graft polymerized to Cohen's silane treated ceramic support membrane. That leaves just the polymeric membranes of the WO reference; but Cohen already has polymeric membranes!

So, the only thing that appears transferable from the WO reference to Cohen would be the use of Cohen's polymeric membrane for separation of catalysts from a reaction mixture such as those described in the WO reference. This, however, would not arrive at Applicants' process, as this combination of references would still result in a process based on the use of a polymeric membrane.

Accordingly, no combination of Cohen and the WO reference could ever lead to Applicants' novel process, and the rejection of claims 2 and 12-14 under 35 U.S.C. 102(b) as anticipated by Cohen, or in the alternative, under 35 U.S.C. 103(a) as obvious over Cohen as applied to claim 1 above and further in view of WO 01/07157 should now be withdrawn.

CONDITIONAL PETITION FOR EXTENSION OF TIME

If any extension of time for this response is required, Applicants request that this be considered a petition therefor. Please charge the required petition fee to Deposit Account No. 14-1263.

ADDITIONAL FEE

Please charge any insufficiency of fee or credit any excess to Deposit
Account No. 14-1263.

Respectfully submitted,
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